patient after having done vertebrobasilar insufficiency tests, "I still don't know if a manipulation will or won't harm you" The pre-test likelihood of occluding or dissecting the vertebral artery that result in harm appears to be extremely low (estimates of serious complication from manipulation begin at 1 in 20,000; Hurwitz et al 1996). Even if vertebrobasilar insufficiency tests were highly sensitive and specific, the diagnostic test should not be done if the patient is unlikely to have the target disorder and the test result would not alter the clinical decision. Most of the people who test positive would not be harmed even if they were manipulated. The decisions differ when the pre-test likelihood is higher; that is, when there is a history indicating caution such as neurological involvement and trauma. The decision would then be to test and treat on the basis of the test's result. Finally, there are situations were we ought to assume that the patient has the disorder (multiple subjective factors like drop attacks, positive neurological findings, 5 "Ds") and avoid the test and treatment.

Will the reference standards that assess blood flow velocity and occlusion accurately detect vertebrobasiliar artery dissection or occlusion causing a stroke or death? The notion that vertebrobasilar insufficiency/blood flow reference tests (ie Doppler sonography) accurately assess the adequacy of extracranial vessels may be only partially correct or flawed. Other theories such as a genetic predisposition in tissue type resulting in arterial anomalies may assist in establishing an accurate reference standard (Norris et al 2000).

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Influence of vertebral artery blood flow research outcomes on clinical judgment

There has been substantial additional research into the effects of cervical movements on vertebral artery blood flow since 1988, when the APA first formalised a Protocol for Pre-Manipulative Testing of the Cervical Spine and recommended its use in patients with upper quarter allows measurements of velocity and flow rate of vertebral artery blood flow, has resulted in a burgeoning of in-vivo blood flow studies.

The outcomes of this research have been conflicting at best and have called into question not only the methodology employed in some instances (Johnson et al 2000) but also the sensitivity and specificity of premanipulative testing, in terms of the ability of these tests to alter blood flow parameters in clinically significant ways in patients versus controls (Licht et al 2000, Rivett et al 1999).

Importantly, what has not been called into question is the ability of the clinician to produce, reproduce and/or independently replicate symptoms in patients which might be suggestive of vertebrobasilar insufficiency, that is to reliably categorise patients as positive or negative on clinical testing (Licht et al 2000, Rivett et al 1999).

Despite conflicting results of vertebral artery blood flow studies, Licht et al found that the majority of Danish chiropractors surveyed would manipulate patients with a positive de Kleyns test if vascular tests (vertebral and internal carotid artery blood flow measures) were considered normal. A positive de Kleyns test has long been regarded by that profession as a contraindication to cervical manipulation. Despite conflicting results too, the new clinical guidelines include sustained end-range rotation as the only minimum mandatory screening test prior to cervical manipulation, with additional cervical movement tests included based upon the physiotherapist's clinical judgment or the patient's nomination.

Using the reliable and comprehensive blood flow procedures of Johnson et al (2000), there is now great opportunity and urgent need to establish the effects not only of cervical movements on vertebral artery blood flow but also the effects of high velocity thrust techniques and end-range rotation mobilisation techniques, thereby contributing to clinical decision making and biomedical knowledge.

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